find the means nor the time to improve skills and personal facility with everyday tasks. The multiplicity of courses on each satellite transponder and the low cost of the receiving terminals make this augmented accessibility possible;

Utility - Developing advanced technology is useful only when that technology is practically applied. Many teachers and administrators have a severe case of technophobia. The YES Networks is a tool to help both students and teachers meet their educational goals. On one level it is as simple to use as TV. On another level, it provides the sophistication of graphics-based personal computers. Even in the latter case, the service is designed to be completely bootstrapping, i.e., someone with no knowledge of the system will be able to use the YES Networks from day one.

The YES Networks will, by greatly reducing acquisition and dissemination costs, introduce new technology which will expand access for America's students to a wider variety of new and improved educational resources. This will include courses by master teachers who are recognized nationally for their instructional excellence. It will also involve realistic simulations and problem solving situations emphasizing integration and application of knowledge, and state-of-the-art "hypermedia" techniques for obtaining and sharing information.

Distance learning has been proven effective[1] and is growing at a rapid pace. As noted by Dr. Frank Withrow of the U.S. Department of Education, "It is possible to use these technologies to reach very isolated students, i.e., handicapped homebound students, students in prisons, students on Indian reservations and even students who are in the workplace..."[2]

The needed growth of satellite distance learning will soon be stymied by high delivery costs, lack of related capabilities (little or no capability to transmit supplementary materials, limited interactivity) and especially a future **shortage of affordable satellite transponders.**[3] Current analog transmission and reception techniques are capable of carrying only one or two TV courses per transponder. There is an obvious need to increase this capability and improve efficiency in current and future satellites to ensure that each transponder can simultaneously broadcast many services.

The relevance of digital DBS to distance learning cannot be overemphasized. It will bring unparalleled flexibility, efficiency and **economy of operation** to educational course broadcasting. It will allow introduction of a vast number of **new educational services never before possible**—all

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1 E. Kent Ellertson, et al, "Report on Distance Learning, A National Effectiveness Study," Pennsylvania Telcteaching Project, 1987.

2 Dr. Frank Withrow, "Star Schools Distance Learning: The Promise" *T•H•E Technological Horizons in Education Journal*, Volume 17, No. 9, May 1990.

3 U.S. Congress, Office of Technology Assessment, *Linking for Learning, a New Course for Education*, OTA-SET-430, November, 1989.

received with antennas convenient to install because they are comparable in size to a student's opened notebook. The system under development by the YES Networks **will assure the future economic availability of adequate satellite delivery capacity** for traditional-type distance learning for the entire nation.

Research is clearly demonstrating that American school children, at all grade levels, perform poorly in math and science on achievement tests in comparison to students from other industrialized nations. In addressing this problem, the National Council of Teachers of Mathematics developed its "Math Framework"[1] to provide a cohesive national plan for upgrading math education. However, there is a shortage of teachers possessing master teaching competencies in mathematics and science, particularly in rural and small school districts.

Several barriers exist to implementing the needed changes. These include:

- Many teachers are poorly prepared to provide science and math instruction;
- Current text and workbooks do not contain sufficient material to allow students to develop and practice higher-order thinking, and;
- Computers are primarily being used only to provide drill and practice of basic facts.

According to Ewell,[2] one solution is to use distance-teaching technologies to share master teachers among many schools and classrooms. These specialists exhibit exceptional teaching strategies, superior motivation and communication skills, sound curriculum knowledge, interpersonal competence and classroom management proficiencies. This can provide an effective alternative to traditional instruction in terms of student satisfaction, content mastery and cost effectiveness.

The following are additional examples of educational services and programs which can benefit the public as a result of implementing the **YES Networks**:

- Satellite educational programming to all public and private elementary and secondary schools in America;
- Much improved access of rural schools to educational programming;
- Enhanced parental involvement;
- In-service training to teachers;

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1 "Curriculum and Evaluation Standards for School Mathematics," National Council of Teachers of Mathematics, October 1987.

2 Ewell, Y. (1982). Use Technology to Cope with the Scarcity of Math and Science Teachers. *American School Board Journal, 169*(9)26

- Information data streams to all libraries in America;
- Transmission of informational and innovative materials to/for schools, PTAs, school boards, administrators, teachers, their national associations, and the U.S. Department of Education;
- Specialized programs for vocational-technical schools;
- Drug prevention and rehabilitation education;
- Specialized programs for disadvantaged, gifted, talented youth;
- Training and educational advancement programs for businesses and industries;
- Lifelong education, including graduate studies;
- Educational programming to all child-care centers in America;
- Emergency Broadcast System to schools (tornados, earthquakes, floods, fires and other catastrophes);
- Adult literacy;
- Student remedial programs;
- Senior citizen learning opportunities;
- Support of the Job Corps training programs;
- Education and training required under federal occupational safety, health, and environmental laws;
- Professional re-qualification training as required by state laws;
- Medical information interchange among medical facilities;
- Education and data transmission to support migrant students;
- Assist prison inmates rehabilitation programs;
- Relay of educational programming to Department of Defense-operated schools;
- Professional training and informational services (legal, accounting, financial, medical, engineering, etc.);
- Parent education in home or school.

During after-school and evening hours the YES Networks will implement a student incentive program delivered via DBS to subscribers. It will provide student and teacher assistance including "point" accumulation for a variety of rewards for participation, ranging from commercial products to a college education.

Comparison	Present Systems	YES Networks
Recipients of Services	Schools, Businesses	Schools, Businesses, Homes (also mobile), Hospitals, Libraries, Community Centers, Child Care Facilities
Receiver Antenna Size	8 to 12 ft. diameter	1.5 ft. Square Plate or Other Miniature Antenna
Local Zoning for Antenna	Very Restrictive	Not Restricted (Preempted by FCC)
Installation	Construction, Pedestal, Sometimes Needs Fencing	No Construction or Pedestal, Set up Indoors Through Window or Skylight
Types of Services	TV Lectures	TV Lectures, Computer Lectures, Written Materials, Teacher Aids, Remedial/Advanced Programmed Learning, Interactive HyperMedia, and Others
Simultaneous Courses in One Satellite Transponder	One (Possibly Two)	100 (Estimated)
Satellite Transmission Cost of One Course	100% (Reference)	1% to 5% (of Reference)
Flexibility of Service	Very Limited	Extremely Flexible
Support for Interactivity	Only by Telephone Line	Classroom System Interactivity, Both During Broadcasts and Off-Line, using HyperMedia, Computer Networks, Voice Mail
Origination Facilities	TV Studio and Crew (Relatively Expensive)	YES Networks Studio, College Campus, Instructor's Office, or Other Location (No Studio or Crew Required)

Once such a system is created and implemented through a network of users, there will be little reason for any school or student to be deprived of access to an extraordinary inventory of educational programming far in excess of that now available primarily to those that are wealthier. This advance in educational access will be possible not only by introducing new hardware, but also through the pooling of resources in a user network.

The demonstrated use of digital-based communications in education, the lower per service costs, and the increased capability of such a system will be the most persuasive argument for creating a network of users founded in public and private schools and libraries.

There are numerous distance learning programs available today. However, they do not reach more than a tiny fraction of students that need help. The comparison Table above explains the differences between the YES Networks' system and the types of limited services available today.

Tasks to be Performed Under Sturgis Grant

		First Year	Second Year
1.	Receiver Distribution	$ 10,000	$ 10,000
2.	User Network Design	$ 10,000	$ 10,000
3.	Curriculum/Course Development	$ 10,000	$ 10,000
4.	Financial Approaches	$ 10,000	$ 10,000
5.	Reports, Demonstrations, Presentations	$ 5,000	$ 5,000
	Administration and Overhead	$ 15,000	$ 15,000
	Travel	$ 5,000	$ 5,000
	Equipment	$ 5,000	$ 5,000
	Professional Fees	$ 5,000	$ 5,000
	Total Funds Requested	$ 75,000	$ 75,000

The YES Networks concept is an innovative application of technology for the instruction of both students and teachers. In order to identify, implement and evaluate the network requirements, several project tasks must be considered:

Task 1: Receiver Distribution

- Development of distribution system
- Development of necessary user support for initial receiver installation
- Advanced user system training

Task 2: User Network Design

- Characterize the user audience
- Determine network organization
- Development of parental involvement

Task 3: Curriculum/Course Development

- Identify existing software and course content
- Outline YES Networks course development capacity and capabilities

Task 4: Financial Approaches

- Identify the economic factors of a functioning system

- Identify probable economic model
- Assess the continuing financial requirements of the network

Task 5: Reports, Demonstrations, Presentations

- Development of YES Networks presentations materials
- Completion of instructional video tape using innovative video techniques similar to those which will be used in programming over the YES Networks
- Written interim and final reports to Trust

Equipment is required for two purposes. (1) A large amount of documentation and communication is necessary between geographically dispersed resources, collaborating technical and educational organizations, and national educational organizations. The vast majority of the working documentation will be in electronic form, including some (e.g., Hypercard stacks, animated presentations, and others) which have no printed equivalent. This will require additional personal computers, peripherals, and communications equipment (e.g., fax and modems). (2) Hardware (computers, monitors, electronic sketch pad, video equipment, scanner, etc.) is needed to develop and present the necessary demonstrations to show the wide array of services that will be offered by the YES Networks.

The final report preparation will entail both a written document and a video tape, the latter of which will not only present results, but will also be instructional in the services envisaged.

Travel funds are needed for meetings with involved technical and educational organizations and individuals. The proposed duration of the planning study is two years.

FEAT personnel will perform much of the actual work and will subcontract portions to appropriate organizations such as Advanced Communications Engineering (ACE) and its personnel for evaluating technological factors. FEAT will provide an accounting of expenditures of funds each year in its reports. Vitae of the key personnel of FEAT and ACE are included in Appendices A and B respectively.

Conclusion

It is difficult at best to introduce new technologies and unique ideas - no matter how practical and efficient they may be. However, the global competition facing the United States in the next century demands that the greatest benefit be obtained from our shrinking educational resources. The **YES Networks** can multiply the effectiveness of each school dollar spent for distance learning by a significant factor. Imagine a classroom where the student operates in a world of color, sound, and animation — a world where master teachers are made equally available to children in the smallest rural or largest urban schools alike.

Digital-based satellite communications can and will deliver educational programming much more efficiently than current alternatives. New communications hardware using this technology will permit the transmission of many times the programming now available through analog delivery equipment and will allow inclusion of innovative services that are not presently possible. Implementation of the YES Networks will improve learning opportunity for all students and teachers.

Development of the **YES Networks** will result in an effective national distribution of educational programming of the scope needed to revitalize and revolutionize the nation's school systems. Ultimately, **YES Networks** will embrace every public and private educational institution in America as digital technology greatly reduces the costs of participation. The networks will standardize scheduling, identify needs and develop programming, provide training, and create a forum for the exchange of ideas and recognition of teaching excellence.

Technology has changed the world forever. The future belongs to those who make appropriate use of this technology. The place to begin is the schools of Arkansas and America — with the **YES Networks**. The requested funds will allow the Foundation to do planning necessary to implement these technologically innovative educational services.

includes "command aided questions about ACE's Digital DBS Distance learning system

YES Networks
Digital DBS System

A Presentation to:
National Educational Associations
and other interested parties

Hosted by: National School Boards Association

January 14, 1991

Foundation for Educational Advancement Today

Agenda

- **Introduction**
  Jim Mechlenburger
  Dan Garner

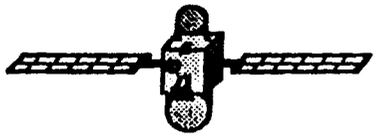
- **DBS Technology**
  Don Dement

- **DBS Business**
  Scott Finer

- **YES Networks**
  Dan Garner

- **Discussion:**
  What you can do

- **Adjourn**

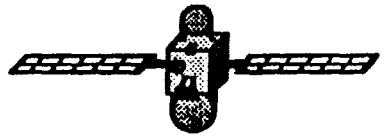


ACC's Digital DBS System

A Presentation to:
NSBA

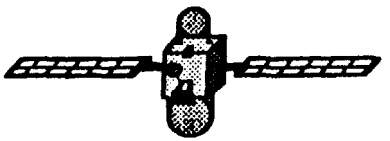
January 14, 1991

Donald K. Dement



Satellite Direct Broadcasting In The United States

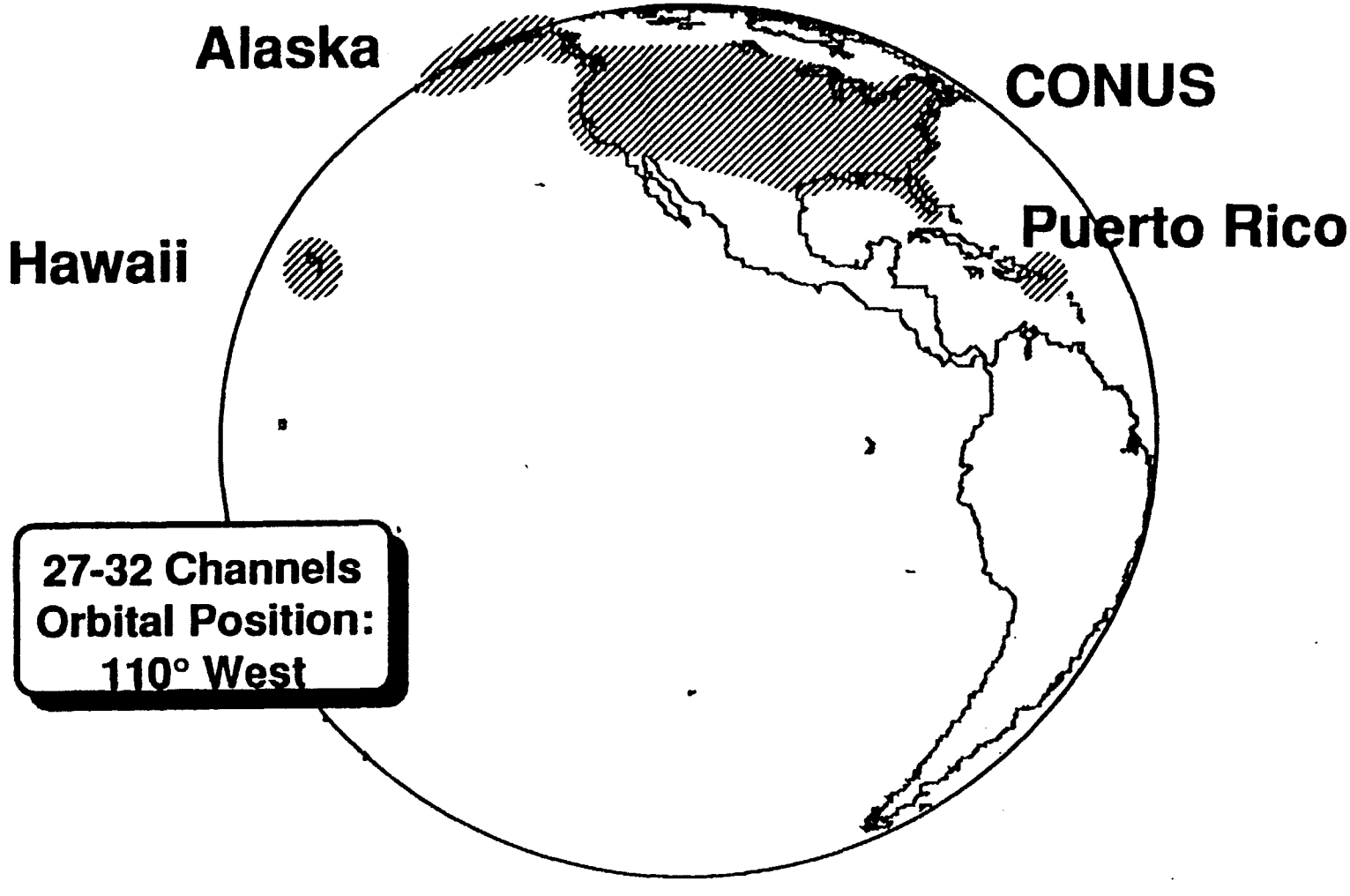
- Regulatory bodies specifically guided Western Hemisphere DBS architecture.
- Orbits were allocated with nine-degree spacing for non-interference when using small antennas:
  - 61.5, 101, 110, 119 W Long. (E-1/2)
  - 148, 157, 166, 175 W Long. (W-1/2)
- An exclusive frequency band was allocated for high downlink power to small antennas:
  - 12.2-12.7 GHz user downlink
  - 17.3-17.8 GHz feeder uplink
  - Power levels permit reliable reception with 18-inch antennas
- Improved satellite technology today:
  - 16 180-watt xpdrs per satellite.



FCC Construction Permit History And Characteristics

- Comsat began "STC" DBS program 1981, many others applied since.
- Most applicants have cancelled, abandoned, or been rejected by FCC
- ACC applied in 1984, original construction permit approved in 1984, amendments approved 1986 and 1989
- Eight permittees remain today, but only ACC and Hughes have both:
  - orbital locations that permit full-U.S. high elevation angles
  - max. number of xpdrs allocated by FCC per location: 27
- ACC now granted 16 transponders at 110W (full-CONUS/E-1/2) and 148W (W-1/2)
- ACC requests pending and expected in early 1991: 11 more xpdrs each location

Orbital View of Full Coverage Area

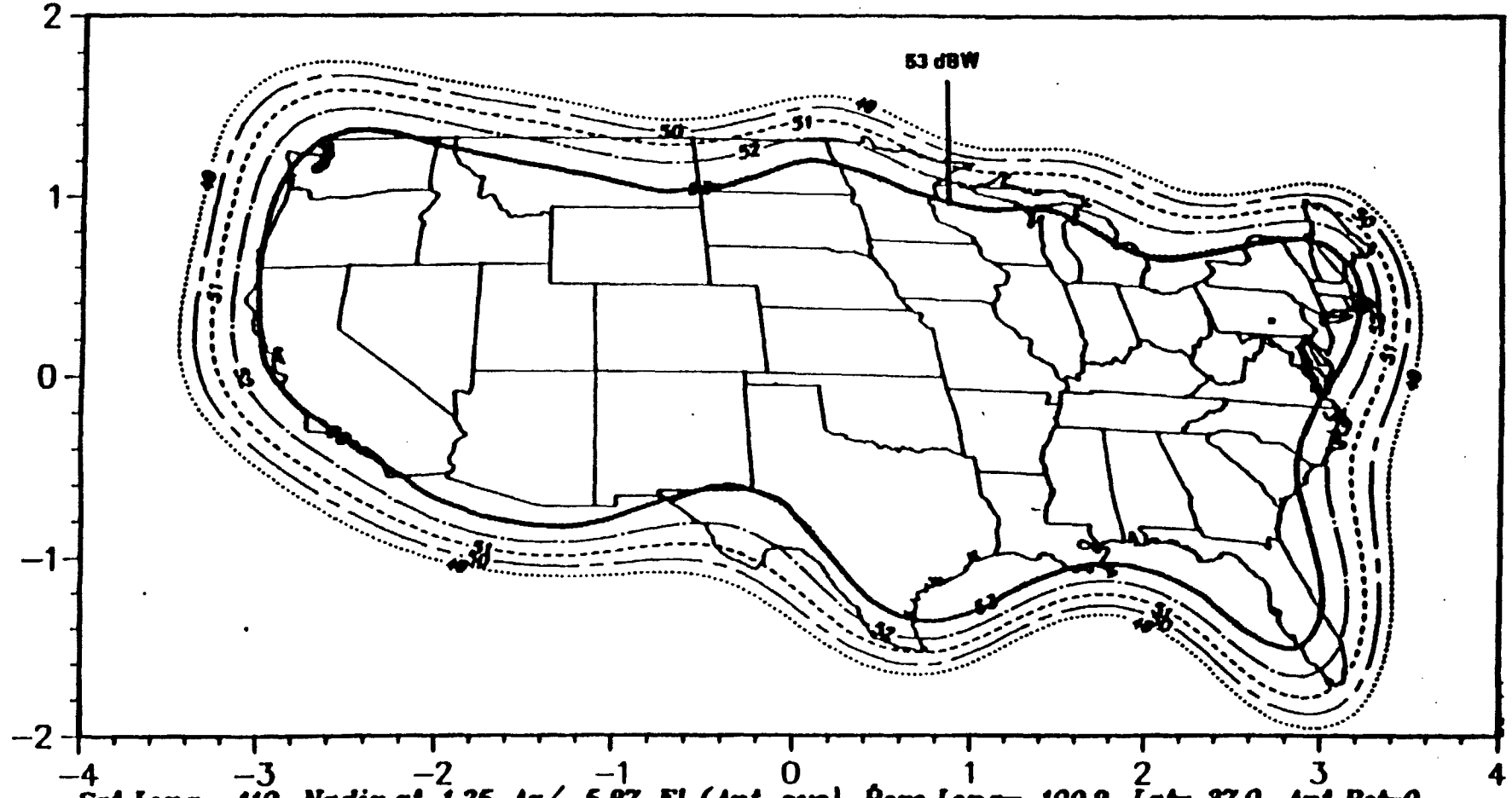


Satellite Characteristics

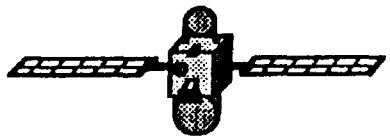
- **Heritage: Body-stabilized Advanced Satcom (RCA); AT&T Telstar 401 series**
- **Payload:**
  - **simple repeater: 16-channel block convertors, HPAs, output mux**
  - **180-watt traveling wave tube vendor selection in process**
  - **shaped-beam transmit antenna keeps EIRP near 53 dBW over all CONUS**
  - **reliability is set by 12-for-8 TWTs in two banks**
- **Bus:**
  - **lifetime: based on nominal launch, exceeds ten years, likely 14**
  - **weight: targeted at 7200 lbs to GTO**
- **Power subsystem:**
  - **full operational power during eclipse using NiH2 batteries**
- **Stationkeeping and attitude:**
  - **Arcjets N-S, hydrazine E-W; reaction wheels for attitude**

Transmit CONUS Beam - Eastern Orbit (110° W) EIRP Contours (dBW)

CONUS with 180 watts power
Satellite at 110° WL



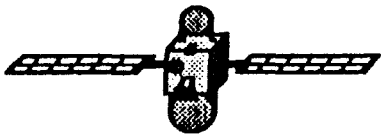
Sat Long=−110 Nadir at−1.25 Az/−5.87 El (Ant−sys) Bore Long=−100.9 Lat= 37.0 Ant Rot=0
Yaw Rot=0 Freq= 12.450 GHz LC−POL Conv Factor= 20.30 dB Peak= 54.98 dB

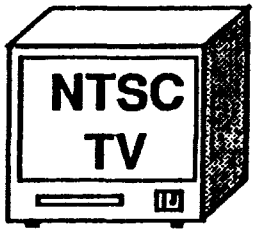


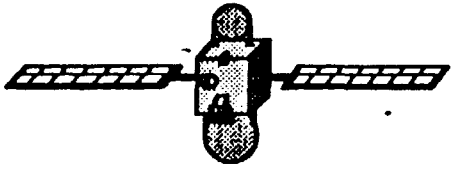
Digital Satellite Broadcasting

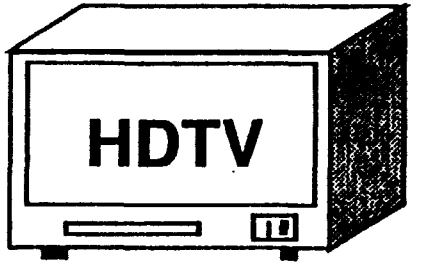
- ACC pioneered concept of using digital RF modulation for DBS in 1987
- Principal requirement: extraordinary flexibility compared to NTSC TV
- Single time-division-multiplexed stream at 32 Mbps in each 24 MHz xpdr
- TRW study for CBS in 1981 concluded digital best; CBS: "too expensive"
- Hardware technology now permits user terminal at a reasonable price
- Terminal capabilities now are expanded to include innovative services

Converging Technologies: Expanded Services





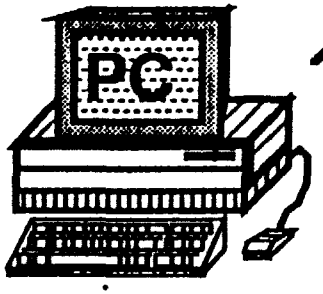




Converging Technologies

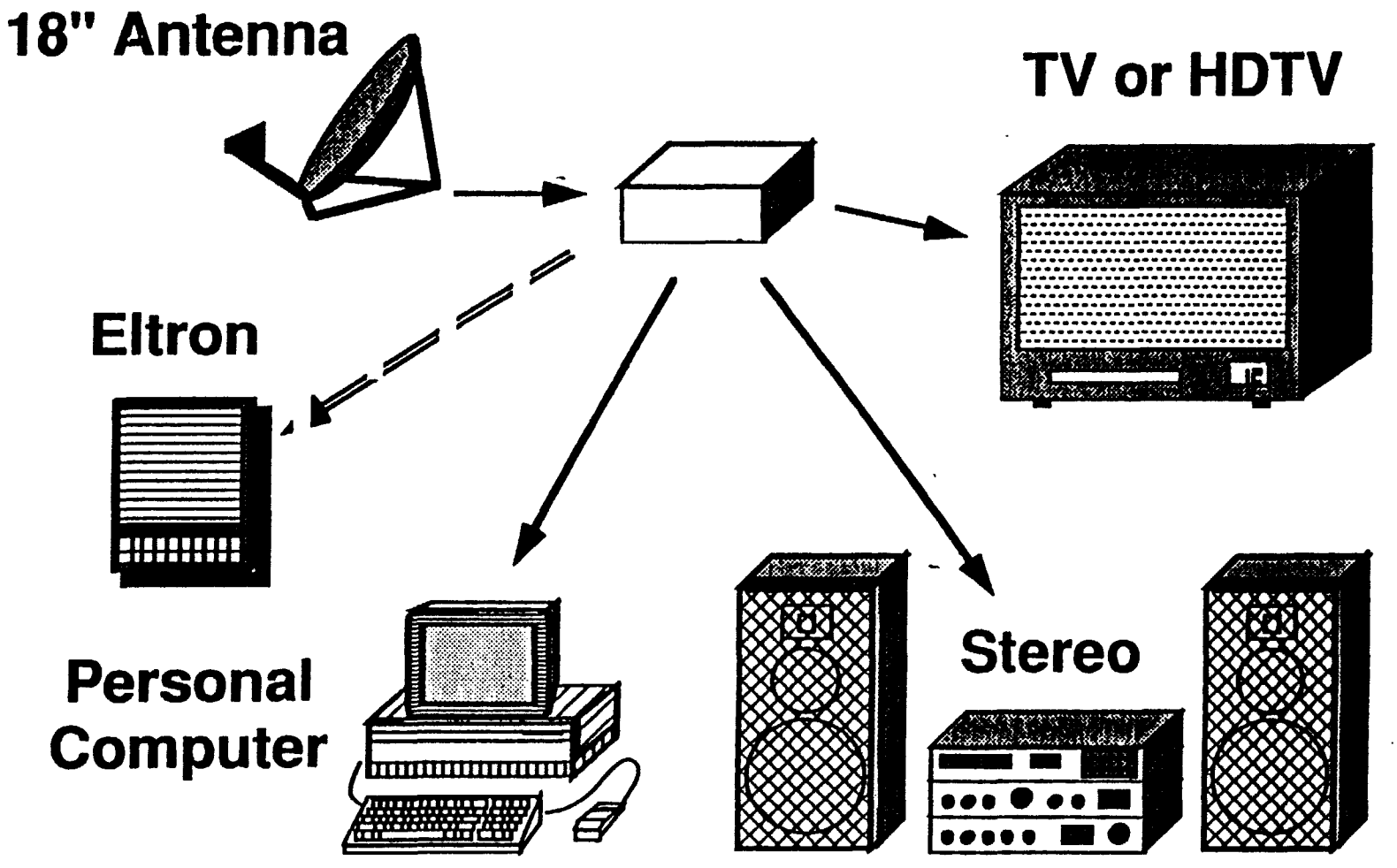
Digital DBS Broadcasting

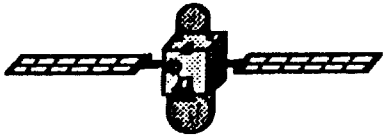
Expanded Spectrum of Services



New low-cost services (e.g., Education)

Receivers





DBS Receiving Antennas vs. C-band TVROs

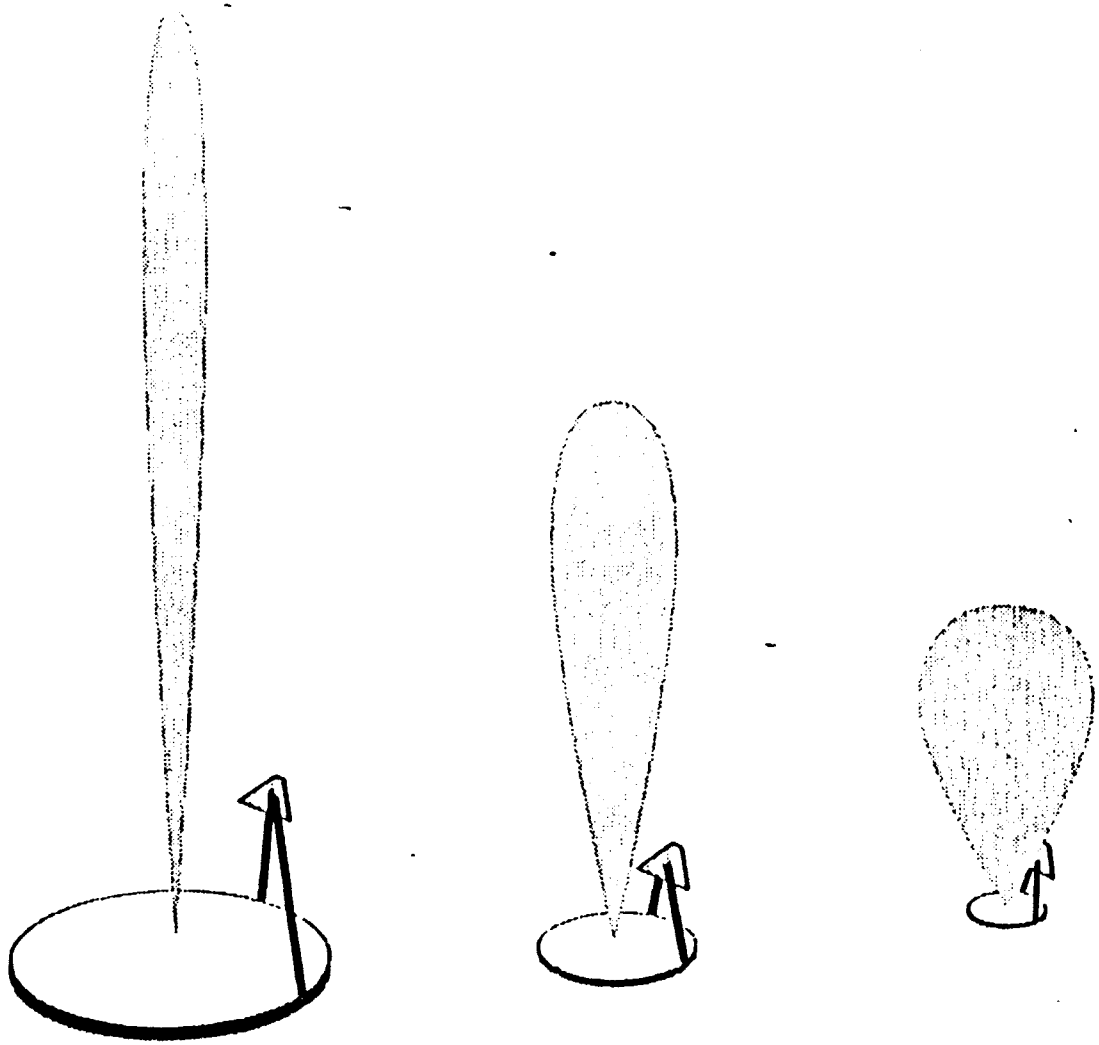
1 - Frequency: DBS band (12.2-12.7 vs. C-band TVROs	Factor
smaller wavelength	3.25
higher antenna efficiency	1.4
worse noise	0.50
higher rain losses	0.50
2 - Modulation: digital vs. analog	
less signal power for same quality	1.40
3 - Satellites: higher power, better antenna	
180 watts DBS vs. 8-12 watts C-band FSS	4.20
DBS shaped beam has even power distribution	1.20
Total difference:	**8 times**

Therefore: a 12-foot C-band antenna reduces to 18-inches for DBS

source: space systems / Loral

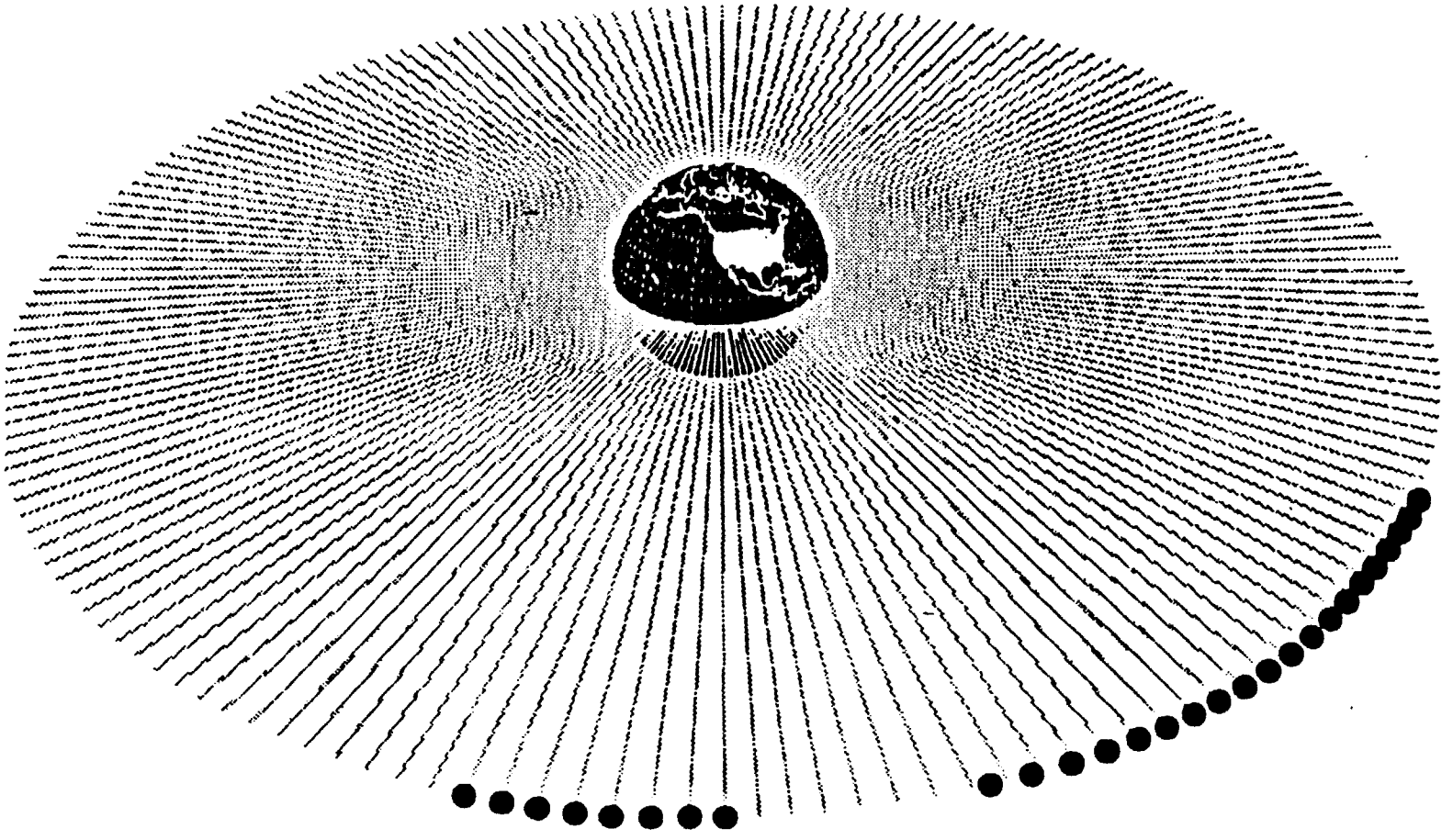
Foundation for Educational Advancement Today

Antenna Beam Shapes



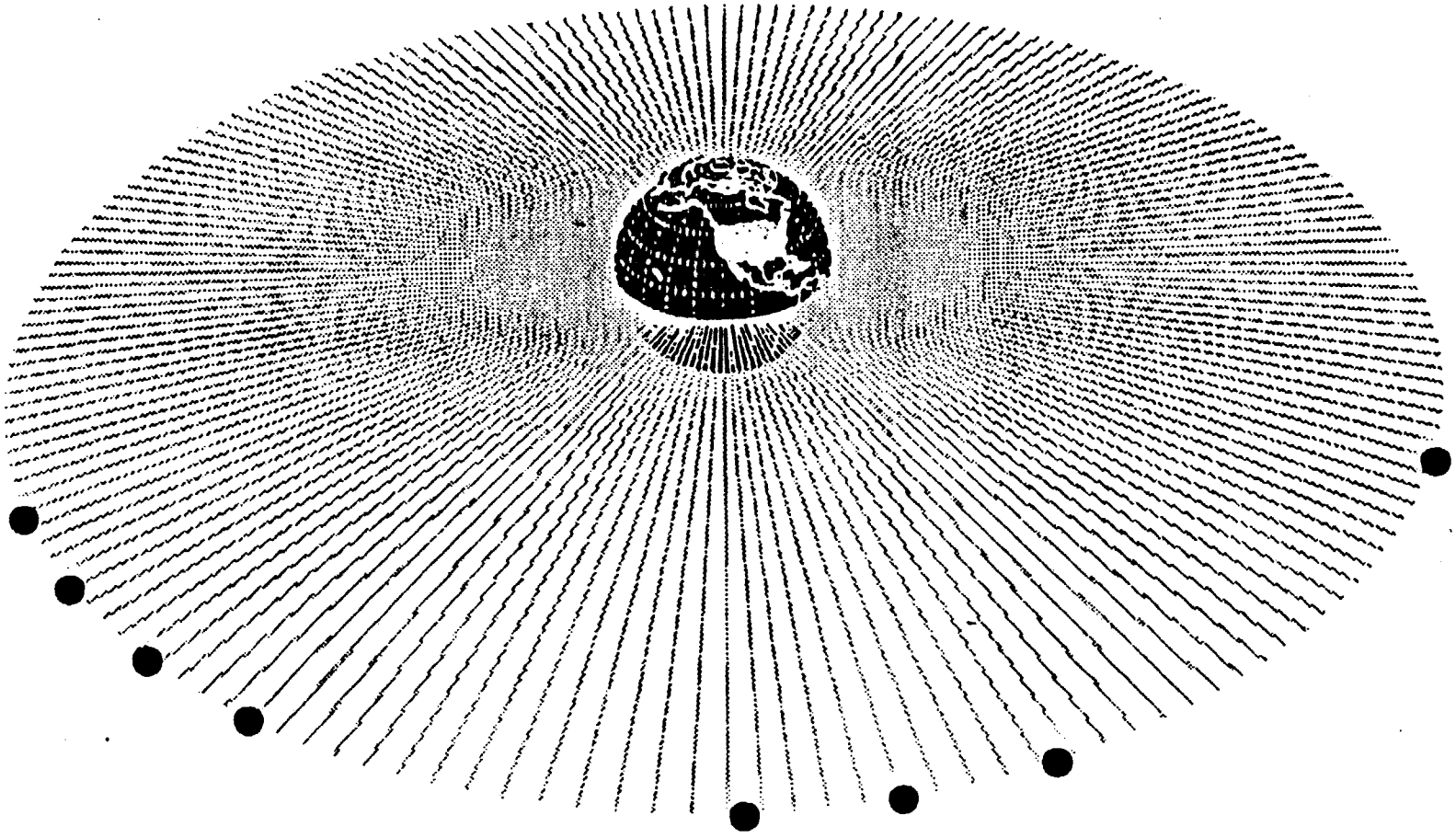
source: space systems / Loral

2 Degree Spacing Ku-band



source: space systems / Loral

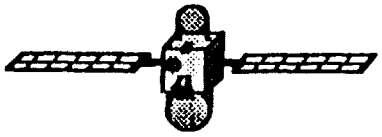
9 Degree Spacing DBS-band



source: space systems / Loral

ACC Development Program Summary

- Regulatory process nearly complete
- Satellite contract under way
- Launcher selection and discussions under way
- Insurance elements under discussion
- Essential user terminal industry awareness beginning



What is High Power DBS?

- An advanced satellite transmission system using very high power TWTs

- The high power allows ground receivers to become very small and very inexpensive

- The high power requires 9 degree orbital spacing allocations from the FCC to prevent interference

- The small, inexpensive ground receiver permits a mass market demand to develop for "personal satellite ground stations"

- Equipping every school and library in America is a realistic concept without massive public expense